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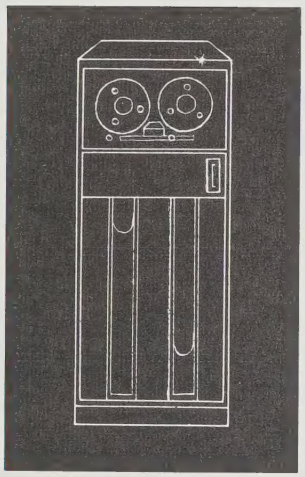
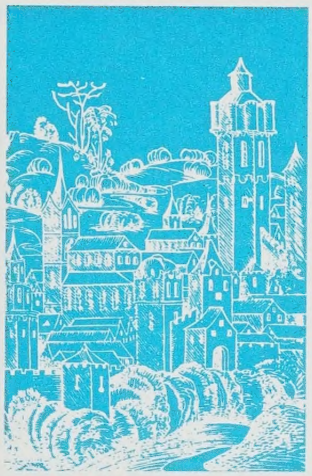
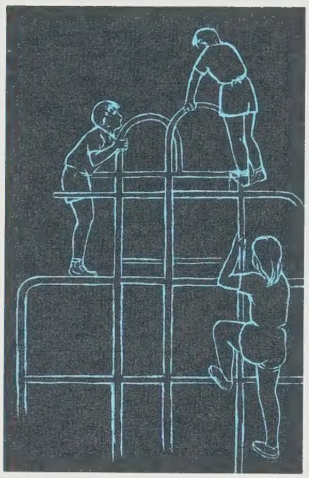
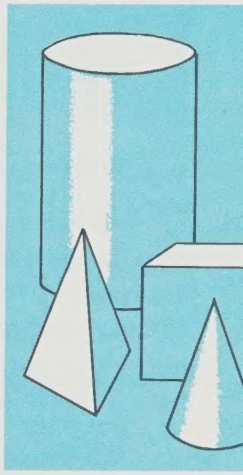
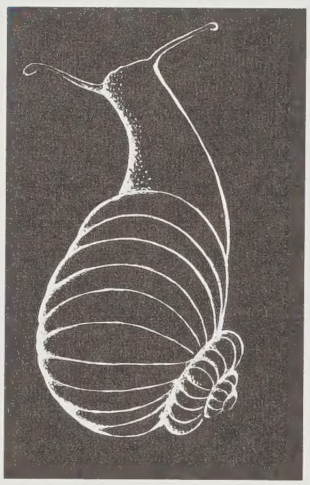
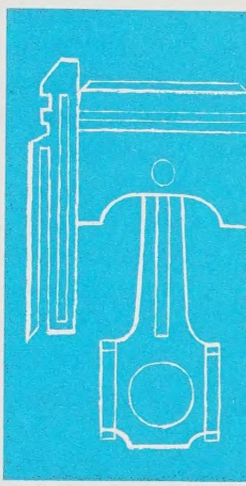
Educational Television Series 1968-69

Teachers' Guide

Mathematics INTERMEDIATE DIVISION

Settings in Geometry

Educational Television Branch
ONTARIO DEPARTMENT OF EDUCATION
1670 Bayview Avenue, Toronto 17

MATHEMATICS
Intermediate Division

SETTINGS IN GEOMETRY

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1670 Bayview Ave.,
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INTRODUCTION

This series of seven programs relates mathematics to other subject areas such as art, geography, science, etc., and where possible presents practical applications of the mathematical topics considered. In some cases, historical references are used to provide some insight into the development of the topic. Models and animation are used to simplify the presentation of some of the mathematical concepts. Although listed specifically for Grades 7, 8, 9, 10, these programs could be used at other grade levels, to stimulate interest and further study of the topics. It is suggested that students be equipped with writing material to note any difficulties or points of interest during the program. These brief notes would be useful in the subsequent post-viewing activities.

PROGRAM 1

CONGRUENCE

The aims of the program are to introduce some of the notions of congruence and to illustrate practical situations that are based on congruence.

PROGRAM CONTENT

The program begins with a scene to illustrate the importance of the congruence of certain objects; the keys to a car. A visit to a clothing factory shows how congruence is applicable and necessary. From the designers' plans to the final product, the student is shown each step of the process and the relevant notions of congruence are introduced. The importance of congruence in the manufacture of coinage has been necessitated with the increased use of vending machines in many areas of consumer purchasing. A visit to a paper company shows the manufacture of a box from its early planning stages to the final product, in each step, illustrating the applicable notions of congruence. The application of congruence to the stacking of chairs and to the world of sports is shown. A further example of congruency is shown in the manufacture of lead shot. From a tower approximately 100 feet high, molten lead is dropped into a cold vat of water. As the molten lead drops, spherical droplets are formed and their shapes are fixed when they fall into cold water. The importance of having congruent pieces of lead shot is described and the use of lead shot in the manufacture of shot gun shells is discussed.

SUGGESTED PRE-VIEWING ACTIVITIES

Since the program shows clearly the concept of congruence, the students could be asked to look for answers to these questions:

1. What is meant by congruence?
2. What practical situations demonstrate congruency?

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss points of interest in the program and clarify difficulties arising from it. Develop the meaning of *congruence.*
2. Discuss the role that congruence plays in the mass manufacture of clothes, boxes, lead shot. With each product, give reasons for the importance of congruency.
3. Relate the manufacture of lead shot to science by asking these questions.
   - On what scientific principle is the manufacture of lead shot based?
   - How is the formation of spherical raindrops related to the making of lead shot?
4. Have the class list examples of congruence from their experiences and environment. Supplement their list with these suggested examples:
   - the stacking of chairs
   - baling hay
   - the storing of boxes in a warehouse
   - the construction of a large brick apartment block
   - the laying of a tile floor, or mosaic bathroom
   - the purchase of a shirt or dress
   - repairing a car
   - stamp collection or coin collection
   - fixing a flat tire
   - replacing a broken window
   - sugar cubes in a box
5. Discuss the possible application of the principles of congruence with the list of examples.

Reference

REYNOLDS, J. — *Shape, Size and Place,* MacMillan Co.

PROGRAM 2

PERSPECTIVE AND ART

The aims of the program are to introduce the notions of perspective by relating them to the works of past and contemporary artists, and to illustrate how the principles of perspective are used to create a three dimensional illusion on a two dimensional plane.

PROGRAM CONTENT

Mr. Kenneth Danby, an artist, is interviewed at his home in Marden, Ontario (Guelph) to obtain some of his views on what perspective means to an artist and how it is used. "Towards the Hill" and "The Red Wagon" are two examples of his art that are examined with respect to the properties of perspective illustrated on the program. Works of many artists are seen on the program to exemplify the properties of perspective.

The work of the sixteenth century German artist Durer involved the use of a glass frame with grid lines on it to help him study the problems of perspective involved in his paintings. Perspective allowed him to create the illusion of a three dimensional picture on a two dimensional plane. For example, objects nearer the horizon must be drawn smaller than they really are. To create the illusion of depth the space between equally spaced objects must become smaller as they recede on the two dimensional plane of the canvas. The term parallel perspective and the method

of locating vanishing points are introduced by means of the works of the great artist da Vinci, Tintoretto, and Canaletto. It wasn't until the latter part of the 15th century that some Italian artists and architects began to codify the rules for drawing in perspective. Examples of linear perspective are shown from the works of da Vinci, Durer, Vermeer. During the 18th and 19th centuries, the ideas on perspective spread to America. The work of the American painter Thomas Eakins indicates how extensively linear perspective began to be used. Not all artists use linear perspective today. Picasso intentionally distorts perspective to obtain a certain effect that could not be obtained otherwise. Artists like Andrew Wyeth in the United States and Alex Colville in Canada are introduced and their work is illustrated. Many artists who have mastered the principles of perspective eventually apply intuitively the concepts of perspective to the canvas, but only after a long and careful study.

SUGGESTED PRE-VIEWING ACTIVITIES

The intention of the program is not to teach all the principles of perspective but rather to introduce some aspects of the topic by means of a visual experience. Therefore it would be useful if the students were familiar with some of the principles of perspective. Some of these will be known already, having discovered them in picture-making activities. The following questions could be used as a preparation for the telecast;

1. Have the class discover some understanding of perspective by
   - doing picture-making of a scene containing at least one building, each student taking a different position in relation to the building or buildings to ensure a variety of points of view.
   - drawing various solid models, boxes, tin cans, balls from different viewpoints.
   - drawing two-dimensional geometric shapes and making them look three-dimensional.
2. Discuss the problems and difficulties encountered in creating a three dimensional effect on a two dimensional plane.
3. Study photographs and works or prints of art to identify and establish intuitively some principles of perspective.
4. Use a flashlight or other source of light to project images of the following geometric shapes on a wall or screen: ellipse, triangle, line segment, circle, hexagon, etc. Discuss how some images remain similar, and how some images of geometric shapes can be obtained in different ways, e.g. an elliptical projection obtained from a circle or an ellipse.
5. Determine the meaning of the terms, perspective and projection and their relationships.

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss points of interest in the program and clarify difficulties arising from it.
2. What does perspective mean? Projection? In view of the ideas visualized on the program, how are they related?
3. Discuss what is meant by the following terms:
   - parallel perspective, vanishing point, angular perspective, foreshortening, linear perspective.

   What other types of perspective are there? One example is color perspective. What does it mean and how is it used?
4. Examine various photographs, drawings, etc. and establish what properties of perspective are exemplified. Use the following points as a guide; in projection (perspective).
   a. the following are preserved:
      - intersecting straight lines intersect
      - straight lines remain straight lines
      - triangles remain triangles (a line might be obtained in a special situation)

      What other aspects are preserved?

   b. the following are not preserved:
      - circles and ellipses
      - midpoints of lines
      - right angles (size of angles)
      - parallel lines
      - length of lines
      - area

      What other aspects are not preserved?
5. Discuss how perspective is related to the creation of an optical illusion.
6. The following two groups of artists were noted on the program:
   a. Durer, da Vinci, Tintoretto, Canaletto, Vermeer
   b. Bridget Riley, Thomas Eakins, Picasso, Andrew Wyeth, Alex Colville, Ken Danby, Frank Wright, Frank Stella, Buckminster Fuller.

   The students could be assigned a project to identify each of these artists and relate their work to the principles of perspective seen on the program. Examine their work and see if the following apply:
   - a three dimensional effect is created
   - objects in the distance appear smaller than they really are in real life
   - the spaces between equally spaced objects become smaller as they recede towards the horizon.

References

KLINE, MORRIS, *Mathematics for Liberal Arts,* Addison-Wesley

LAND, FRANK, *The Language of Mathematics,* Longmans Canada Ltd.

NORTON, M., *Geometric Constructions,* McGraw-Hill

RAVIELLI, ANTHONY, *An Adventure in Geometry,* MacMillan Co.

Discovering Perspective (Film in colour, 16 min.), Film Associates of California; Audio-Visual Division, Department of Education, 559 Jarvis St., Toronto, or Canadian Film Institute, 1762 Carling Ave., Ottawa.

PROGRAM 3

MOTION

The aims of the program are to present many examples of motions that can be described by geometry, and to illustrate practical situations in which the properties of certain geometric curves are used for a specific purpose.

PROGRAM CONTENT

When man builds he builds with geometry and uses geometry to describe many kinds of motions. The first type of motion that is seen involves the straight line. A sequence of situations illustrates that when man builds, he controls motion. In nature, straight line motion is difficult to find since gravity pulls free falling objects in certain smooth curves. The program then continues to illustrate how man puts motion to use. The history of the Foucault pendulum illustrates that the cause of motion is not always obvious. Many motions utilize the properties of the circle. Circular motions are seen in many examples: potter's wheel, fly-ball governor, water-wheels, etc. The properties of some additional geometric curves are used to obtain some strange and interesting motions. Another type of motion that is considered is derived from a cycloid. The students are then shown how this curve is obtained, and its properties are illustrated: curve of steepest descent, curve of equal descent. How does man make use of geometry in motion? As machines have become more complicated, man has learned to transfer motion in mechanical ways: gears, propellors of airplanes and boats, sails of a dinghy. The program closes with further examples on how man uses geometry to obtain motion.

SUGGESTED PRE-VIEWING ACTIVITIES

Since the program presents a great number of situations in the world around us where man uses geometry in one way or another to obtain motion, the students should be equipped with writing materials to note the various types shown during the program.

1. Identify the properties of the geometric curves that can be seen in the various motions about us.
2. What are the most common geometric curves that are utilized in motion?
3. State some ways in which man controls motion.
4. In what ways does man use motion to help him build, transport, fly?

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss points of interest in the program and clarify difficulties arising from it.
2. In what ways does man use the properties of the triangle to help him build? (A quadrilaterial is not a rigid figure, but a triangle is.)
3. State examples of circular motion, and identify how man utilizes it in his everyday activities.
4. Have the students list examples of motions and situations from their experiences and environment. Supplement their list with these suggested examples.
   - elevator shaft, oil rigging
   - diving, tennis, bowling
   - a construction site
   - satellite, space travel
   - pole vault, football kick
   - streets and highways
   - potter's wheel, Egyptian water wheel for irrigation
   - wrecking crane, Foucault pendulum, grandfather clock
   - carnival rides, ski jump, water slide
   - helical post hole digger
   - cars, bicycles
   - logs flowing at a sawmill
   - anchor of a boat
   - roulette wheel
   - cement mixer
   - airplane propellor, boat sail
   - weaving shuttle
   - snow plow, farmer's plow
5. For each of the examples identify the basic geometric curves that could be involved, and identify the property(ies) of the curve that is (are) utilized.
6. By using a pencil tied to a circular container (as seen in the program) a cycloid could be drawn and a track built from plywood or hard cardboard. The following properties of the cycloid could then be examined:
   - curve of steepest descent
   - curve of equal descent
7. A great variety of gears are manufactured to obtain various types of motions. Investigate and list the types of gears that are found and establish the basic geometric curve utilized.

PROGRAM 4

NATURE

The aims of the program are to illustrate and identify the many examples of geometric shapes that exist in nature, and to make the children aware of geometry in their environment.

PROGRAM CONTENT

In nature, geometry is found in many ways. A pebble dropped in water forms circles while air bubbles form geometrical shapes which are spherical. The attraction inside a raindrop pulls it in the shape of sphere. The pull of gravity also produces interesting shapes and designs. The program continues to illustrate other geometric shapes. The volcano and the anthill have geometry in common. As mud drys, it may shrink evenly and form patterns which are nearly hexagonal. The same shapes can be seen in the ice at the Arctic, and as the wind and water cut into these basic shapes, other patterns are formed in geometry. Constant wind and water create regular shapes from sand and snow. Geometry that occurs in nature can sometimes be explained. Outward growth is symmetrical and for the trunk of a tree each ring marks a year of growth. Geometry can sometimes be used to provide strength. Examples in nature are shown

which illustrate the strong building properties of tubes and hexagonal shapes. The structure of a stem is seen and the type of geometry involved is illustrated. The nest of a wasp and the honeycomb involve constructions which are based on the shape of a hexagon. The program continues with a number of visuals which illustrate the occurrence of spirals in nature. Young leaves of the cinnamon fern stay protected in a tight spiral until they are grown enough to unfurl. Fossils of spiral shells can be found from many millions of years ago. The program includes an examination of some of the building blocks of nature – the atom. Slime covering a rock is actually made up of one-celled algae. Pollen grains have many geometric shapes: all examples of geometry in nature.

SUGGESTED PRE-VIEWING ACTIVITIES

1. Review the basic geometric shapes; line, circle, square, rectangle, hexagon, pentagon, cone, cylinder, sphere.
2. Identify some of the basic geometric shapes noted in question No.1 from the environment of the school.
3. What are the most common shapes in nature?
4. What basic shapes are seen in the leaves and the stems of different trees, plants, flowers, vegetables, etc.?

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss points of interest in the program and clarify difficulties arising from it.
2. Have the students list and discuss examples of geometric curves found in nature. Supplement their list with these suggested examples:
   - honeycomb, hornet's nest
   - the stems of plants, bamboo, tulip
   - the pattern found on sunflower heads
   - concentric circles in a tree trunk, pebble dropped into water
   - spider webs
   - wind patterns in sand or snow, patterns in a shallow beach
   - shells
   - vine growth on a tree trunk
   - mud cracks
   - eyes of different living creatures
   - volcano, anthill
   - pollen grains
   - the shape of rain drops
   - snowflakes
   - starfish, jellyfish
   - bubbles in a glass of water, or in a pond
3. For each of the following geometric shapes identify examples in nature that exhibit them; triangle, circle, square, rectangle, hexagon, spiral, pentagon, helix, lines, cylinders, cone, sphere.
4. When raindrops fall, the shapes obtained are spherical. An important application based on this observation is used in making lead shot. What is the principle used? Why is the making of lead shot based on it?

References

MOED, J., *Solid Models,* Cambridge University Press, MacMillan Co.

RAVIELLI, ANTHONY, *An Adventure in Geometry,* Viking Press.

PROGRAM 5

SYMMETRY

The aim of the program is to illustrate the properties and types of symmetry obtained from the many examples in nature and in art in the world around us.

PROGRAM CONTENT

Nature is abundant with many symmetrical shapes. In nature, bilateral symmetry is the most common since there is a need for balance for movement in most living things. The program then illustrates reflective symmetry and develops the concept that objects may have more than one axis of symmetry. In the case when there is more than one axis of symmetry we refer to radial or multi-axis symmetry. Examples from nature are used to illustrate this concept e.g. pollen, radioloria. Symmetry with respect to a point and to a line is then reviewed. The question is then raised whether the left and right hand are symmetrical. Is the human face symmetrical? These questions are visually answered on the program. In the world of nature, where bilateral symmetry is so common, the occurrence of asymmetry is sometimes more interesting than symmetry itself. Why is the heart found in such an asymmetrical position in the body? Simple words such as TOMATO have a certain type of symmetry. This word and a number of others are animated to establish the type of symmetry that exists. Translatory symmetry is described by means of examples in nature. Some applications of the properties of symmetry are illustrated in devices that man has ingeniously built. The term spherical symmetry is introduced and the concept illustrated by a number of examples in the world around us. The program closes with a consideration of the term rotational symmetry.

SUGGESTED PRE-VIEWING ACTIVITIES

Some familiarity with the terms mirror image, axis of symmetry, symmetry with respect to a point or line, would be helpful in order to use the program to its fullest extent. Since the program does not attempt to teach all aspects of symmetry, but rather present many visual examples of the concept to promote classroom discussion, the following could be used as a preparation for the telecast:

1. Discuss what is meant by the term symmetry.
2. Have students discover if the human face is symmetrical with respect to some line. From a magazine or newspaper obtain a picture of someone's face, and cut in half along a vertical axis. Show one half of the face in a mirror to obtain the whole face. Repeat the same procedure for the other half of the persons face. Observe if the same face is obtained each time.
3. Examine the buildings around the school and list examples of symmetry that can be found. How does man use the properties of symmetry in architecture and engineering?

4. Nature is abundant with symmetry. Find examples of symmetry in flowers, animals, leaves, insects and discuss whether the symmetry is with respect to a line or with respect to a point.

5. By using colored paper the students could construct symmetrical designs. Examine the finished pieces of work for its *color symmetry.*

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss points of interest in the program and clarify difficulties arising from it.

2. Discuss the meaning of the following types of symmetry introduced visually on the program; bilateral, reflective, radial, spherical, translatory, cyclic, rotational.

3. For each of the following objects, identify the type of symmetry it might have with respect to the terms stated in question No. 2: tetrahedron, snowflakes, equilateral triangle, butterflies, rectangle, jellyfish, horse, square, radiolaria, circle, isosceles triangle, reflection in a pond or lake, sphere, flowers, honeycomb, line segment, hexagon, pentagon, birds, insects.

4. In addition to the examples described in question No. 3 identify other objects and the type of symmetry they have. What objects possess more than one type of symmetry? (e.g. circle is symmetrical with respect to a point and a line.)

5. How is a mirror image related to bilateral symmetry?

6. Find the axis of symmetry for the following:

   a. TOMATO

   b. CHOICE

   c. 8118

   d. TIMOTHY

   Use other names and combination of numbers and examine them for any possible vertical or horizontal axis of symmetry.

References

WEYL, HERMAN, *Symmetry,* Princeton University Press

Discovering Composition in Art, (Film in colour, 16 min.) F.A.C., Audio-Visual Division, Ont. Dept. of Education, 559 Jarvis St., Toronto or Canadian Film Institute, 1762 Carling Ave., Ottawa.

PROGRAM 6

SCIENCE

One of the aims of the program is to illustrate the occurrence of the conic sections — circle, parabola, ellipse, and hyperbola in the various phenomena of science which occur in the environment. A further aim is to show the unifying concept of mathematics since the four apparently unrelated conic curves are related when a plane meets a right circular cone in different ways.

PROGRAM CONTENT

The program begins with a number of examples illustrating the occurrence of geometry in science. The scientist uses mathematics to build a model to help him describe what he is studying. A model can enable him to see how the parts are related and to help him predict what he cannot see, just as we use a globe to help us in our study of the earth. The early Greek astronomers made models of the solar system in order to study motion of the planets, but they placed the earth at the center of the universe. Two thousand years later scientists began to question the accuracy of the Greek model. The conic sections are introduced as the curves of intersection obtained when a plane meets a right circular cone. The circle, ellipse, parabola, and hyperbola are obtained. The application of these curves to various real-life situations is described. Some satellites travel in circular orbits. Planets in the solar system travel in elliptical paths, while some comets follow parabolic or hyperbolic paths. Parabolic paths are very common in science since the force of gravity causes projectiles to travel in these paths. Practical applications of the reflector properties of the parabola are shown. The structure of arches and bridges are parabolic in form in order to correctly resist stress. Where possible, the methods used to obtain the conic curves are shown.

SUGGESTED PRE-VIEWING ACTIVITIES

Since the program is designed to provide visual examples of conic sections for further study, the following questions could be used as a preparation for the telecast.

1. When an object is thrown into the air, what is the geometric curve which it follows? Examine the path of water from a water hose, or from the spray of a large fountain.
2. Use a table lamp to obtain shadows on the wall. If the angle at which the beam of light meets the wall changes, describe the various types of curves that are obtained.
3. Examine bridges, the roofs of buildings, and determine the various types of curves that are used in their construction.

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss points of interest in the program and clarify difficulties arising from it.

2. What is meant by a right circular cone? If a plane is used to cut the cone, what type of geometric curves are obtained?

3. Determine for what angles of the cutting plane in question No. 2, the following curves will be obtained: circle, ellipse, parabola, hyperbola.

4. If the cutting plane is perpendicular to the axis of the right circular cone, what curve is obtained? If parallel cuts are used, describe the change in the curve of intersection.

5. For each of the following examples, determine the type of conic section that might be involved:

   — orbits of comets and planets

   — Jodrell Bank radio telescope

   — fountain spray

   — satellites

- a flashlight beam projected at an angle to the wall
- the roof of the Whispering Gallery in Washington
- car headlight reflectors
- the spans of bridges
- path of a football thrown in the air
- ripples from a pebble dropped in water

6. Using two tacks and string draw different ellipses by the method shown in the program.

7. What is the geometric construction for drawing a parabola, a hyperbola?

References

KLINE, MORRIS, *Mathematics for Liberal Arts,* Addison-Wesley

RAVIELLI, ANTHONY, *An Adventure in Geometry,* Viking Press (MacMillan Co.)

PROGRAM 7

RELATIONS

The aims of the program are to illustrate the nature and properties of different types of mathematical relations in the world around us, and to visually describe some of the mathematical terms associated with the topic of relations.

PROGRAM CONTENT

The approach used in this program to illustrate some of the notions involved in relations, is experimental. Rather than presenting relations in a traditional way, the program uses cartoons and a quiz contest to illustrate the topic.

The program begins with the ETV 500 Auto race. By tracing the events of the race a relation is introduced between the number of gallons used by Smith's car and the total mileage. Ordered pairs of numbers are then introduced, to describe the relation.

The program then takes us to a local quiz contest on relations. In this sequence the teacher could allow the students to answer the questions that are given to the television contestants. A sequence of relations are flashed on the screen. During this sequence, the importance of the order in the pair (a, b) is emphasized. The first type of question is to determine the relation from the ordered pairs which are shown. In the second type of question, the relation is given and the second co-ordinate of the ordered pair is required. The program then takes us to the world of fashion and shows the mathematical relation to the words, midi, mini and maxi.

The program then turns to a problem in a park where some students are playing with a new mathematical relation. Basically the game that they are playing is related to a co-ordinate system in which the axes of the grid are calibrated with the following symbols: ■, □, ●, ○. By considering points in this plane certain relations are examined. The term "colour changer" and "shape changer" as related to relations on this plane are introduced and their meanings described with respect to this grid system.

The program closes with the question: "What is a shape and colour changer?"

SUGGESTED PRE-VIEWING ACTIVITIES

Familiarity with the terms, ordered pair, first, second component or co-ordinate, plotting points, vertical and horizontal axis, is required in order to use the program to its fullest advantage. Since it is not the intention of the program to teach all aspects of relations, the following questions could be used as a preparation for the telecast:

1. Since the students can participate in the quiz contest, they should be prepared to answer questions of the following type:

   i) From the list of ordered pairs what is the relation in each case?

   – (1,1), (2,2), (3,3), (4,4) . . .

   – (5,4), (6,5), (7,6) . . .

   ii) Find the second component of the ordered pair for the relation "is the square of"

   – (1,_), (2,_), (3,_), (4,_). . .

   iii) Find the first component of the ordered pair if the relation is "is the double of"

   – (_, 2), (_, 4), (_, 6), (_, 8)

2. List some ordered pairs that satisfy the following relations:

   i) is five more than

   ii) is one third of

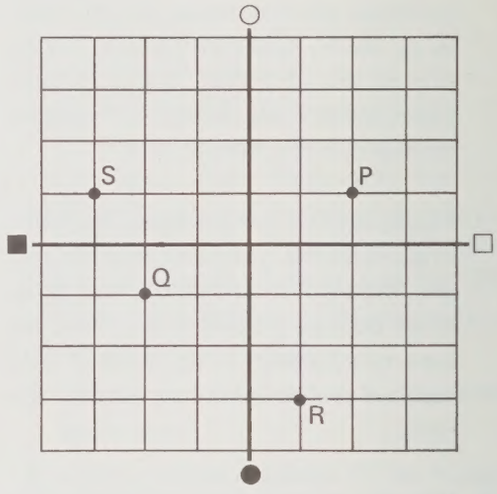
   iii) is equal to

3. The area of a rectangle is equal to the product of the length and width. Write as many ordered pairs of whole numbers as possible of the form (length, width) if the area of the rectangle is 48 square units.

SUGGESTED POST-VIEWING ACTIVITIES

1. Discuss points of interest in the program and clarify difficulties arising from it.

2. The following co-ordinate system was established on the program. The axes of the grid system are labelled as indicated.



The "co-ordinates" of the points P, Q, R, S, are denoted as follows:

P (□□○)

Q (■■●)

R (□●●●)

S (○■■■)

   i) Using the above system find points which are related by the following description which is called a "colour changer relation"

□	replaced by	■
○	"	●
■	"	□
●	"	○

The points P and Q are related in this way.

ii) In the program, the shape changer relation was described as follows:

□	replaced by	○
■	"	●
○	"	□
●	"	■

Find points on the plane which are related by the above. The points R, and S are related in this way.

iii) What do you think is meant by a "shape and colour change" relation?

What points can be related by a shape and colour change?

2. From the following sets of ordered pairs describe the relation:

1. (1,1), (2,2), (3,3) . . .
2. (1,2), (2,4), (3,6) . . .
3. (4,3), (3,2), (2,1) . . .
4. (1,1), (2,4), (3,9) . . .

References

BAILEY, C., *Sets and Logic,* Volumes 1 and 2, MacMillan Co.

DIENES, *Thinking in Structures* No. 2, Hutchinson Educational.

MATHEMATICS – Intermediate Division
SETTINGS IN GEOMETRY
7 programs, 20 minutes each

Prog. No.	CBC 9:30-9:50	CBLT 10:00-10:20	CHCH 9:30-9:50	CKCO 9:30-9:50	CJOH 10:10-10:30	CBOT 10:10-10:30	CKLW 10:00-10:20
1	OCT. 16 FEB. 7 – 9:40-10:00	OCT. 23	OCT. 22	OCT. 21	FEB. 7	OCT. 21	OCT. 21 OCT. 28
2	OCT. 23 FEB. 14 – 9:50-10:10	OCT. 30	OCT. 29	OCT. 28	FEB. 14	OCT. 28	NOV. 4
3	OCT. 30 FEB. 28 – 9:50-10:10	NOV. 6	NOV. 5	NOV. 4	FEB. 28	NOV. 4	NOV. 18
4	NOV. 6 MAR. 7 – 9:40-10:00	NOV. 13	NOV. 12	NOV. 18	MAR. 14 – 9:10-9:30	NOV. 25	NOV. 25
5	NOV. 13 MAR. 14	NOV. 27	NOV. 19	NOV. 25	MAR. 28 – 9:30-9:50	DEC. 2	DEC. 2
6	NOV. 20 APR. 18	DEC. 4	NOV. 26	DEC. 2	APR. 11 – 9:30-9:50	DEC. 9	DEC. 9
7	NOV. 27 APR. 25	DEC. 11	DEC. 3	DEC. 9	APR. 18 – 9:30-9:50	DEC. 16	DEC. 16

SETTINGS IN GEOMETRY